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Virtual Worlds and Gamification to Increase Integration of International Students in Higher Education: An Inclusive Design Approach

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Abstract: In response to the growing trend of internationalisation in education, it is important to consider approaches to help international students integrate in their new settings. One possible approach involves the use of e-Learning tools, such as virtual worlds and gamification. To maximise the potential effectiveness of such tools, it may be beneficial to involve international students in a technological co-design process. This paper develops an inclusive design process based on the definitions of Inclusive Design outlined by the SMARTlab and IDRC teams, as part of a co-design specification in practice, gathering specific information about the needs of Chinese students in Ireland at University College Dublin (UCD) through a questionnaire and an empathy-driven design approach. From the responses of questionnaire, we found that students would find beneficial many features that virtual environments can provide (e.g., 3D campus tours and virtual lectures). We also found that collaborative, social activities were a more popular way to potentially increase language and cultural understanding than structured courses. Finally, we learned that the incorporation of game-like elements in virtual environments requires careful planning: while this may be effective in increasing user engagement with information, users do not want to have to be successful in games in order to gain access to essential resources or information. Based on these specific needs provided by these Chinese students themselves, a virtual campus (VC) which was created in a unique virtual platform called Terf® has been constructed.

Keywords: virtual worlds; e-learning; educational technology, gamification, internationalisation, inclusive design.

Résumé : En réponse à la tendance croissante d'internationalisation dans l'éducation, il est important d'envisager des approches permettant d'aider les étudiants internationaux à intégrer leurs nouveaux environnements. Une approche possible implique l'usage d'outils e-learning tels que les mondes virtuels et la ludification. Afin de maximiser l'efficacité potentielle de tels outils, il peut être favorable d'impliquer les étudiants internationaux dans un processus de co-conception technologique. Cet article développe un processus de conception inclusive basée sur les définitions formulées par les équipes du SMARTlab et de l'IDRC et les exigences empiriques de co-conception, définies en rassemblant des informations spécifiques concernant les besoins des étudiants chinois en Irlande, à l'Université Collège Dublin (UCD), par le biais d'un questionnaire et d'une approche de la conception guidée par l'empathie. Les réponses au

questionnaire nous ont permis de faire ressortir que les étudiants considèreraient comme bénéfiques plusieurs des caractéristiques envisageables des environnements virtuels (comme, par exemple, la visite du campus en 3D et les cours virtuels). Nous avons aussi vu que les activités collaboratives et sociales constitueraient un moyen plus populaire que les cours structurés en vue d'accroitre potentiellement la compréhension linguistique et culturelle. Finalement, nous avons appris que l'intégration d'éléments de type « jeu » dans des environnements virtuels requiert une planification soignée : tandis que cela peut être efficace pour augmenter l'intérêt de l'usager pour l'information, les usagers ne veulent pas avoir à réussir aux jeux afin de pouvoir accéder aux ressources ou informations essentielles. C'est en se fondant que ces besoins spécifiques énoncés par les étudiants chinois eux-mêmes qu'un campus virtuel (CV) a été créé sur une plateforme virtuelle appelée Terf® spécialement construite à cette fin.

Mots-clés : Mos clés : conception inclusive, mondes virtuels, e-learning, technologie éducative, ludification, internationalisation.

Introduction

Over the last decade, Ireland saw an enormous growth in the number of international students: in the development of its strategy for international education for the future, the Irish Department of Education and Skills noted that, from 2010/2011 to 2014/2015, the number of international students attending Irish higher education institutions increased by 58%, from 20,995 to 33,118. This growth was mainly driven by a rise in students from outside the European Union, with an upsurge of 85%, from 11,604 to 21,440; in comparison, there was an increase of 25% in the European Union student group. Moreover, there was a notable increase in the numbers of students from Asian countries studying in Ireland, with 4,448 in 2010, rising to 10,094 in 2014/2015. China was one of the main contributors to this increase. Since 2010, the Irish government has attached importance to the development of its process of internationalisation in higher education, emphasising: (1) the positive impacts of multicultural relations in enhancing the quality of learning, teaching and research for teachers and students in Ireland; (2) the importance of accelerating the cultural integration of international students with Irish students and their wider communities; and (3) the importance of international institutional and research networks. In the next five years, higher education institutions in Ireland will continue to focus on quality and building long-term engagement with students and partners worldwide. Strategy 2016-20 sets a target of 44,000 international students in higher education by the end of the 2019/2020 academic year (Department of Education and Skills, 2016).

However, integration of international and domestic students may not occur spontaneously, and interventions may be required to facilitate greater inclusion (Kudo, Volet & Whitsed, 2017). A report published by the Immigrant Council of Ireland in 2008 reveals that, "those migrating from China, India, and Lithuania often had limited knowledge of Ireland beyond familiarity with some pop music

groups, soccer, tourist information, and the weather" (Feldman, et al., 2008, p. 65). The report states that the new arrivals can often feel socially and culturally isolated in this unfamiliar country if they find it difficult to integrate into the local environment with Irish students and wider communities. Issues such as blockages in cultural understanding, language barriers, the complexities of cross-cultural collaboration, and – for students from China in particular – the differences between teaching styles at Irish and Chinese universities, must be addressed (Feldman et al., 2008). This suggests that strategies to improve the inclusion of international students in Irish universities must now be developed.

Virtual Worlds, Games, and Gamification

One potentially effective strategy involves the use of virtual worlds (VWs). In recent years, immersive 3D VWs (in which each user is represented by an avatar that they can control to navigate and manipulate the 3D environment) are being used to facilitate learning in innovative ways, including for cultural and language learning through cross-cultural collaboration (Berns, Gonzalez-Pardo, & Camacho, 2013; Shih & Yang, 2008; Ligorio & van Veen, 2006). VWs may provide features that lead to more effective learning environments, such as flexibility, interactivity, collaboration, and optimal feedback (Reisoğlu et al., 2017). Increased international collaboration may be facilitated in virtue of the fact that VWs are typically delivered via the Internet, and VWs are used for distance education (Schoonheim, Heyden, & Wiecha, 2014; Wang & Lockee, 2010). This may allow international students preparing to move to a new country to begin the integration process before leaving their home country by experiencing a virtual version of the university to which they are preparing to move. In the context of higher education, students are shown to value the affordances of VWs, such as the ability to experience learning content in a more immersive way, and the opportunity to socialize and collaborate with others (Hew & Cheung, 2010). While collaborative activities are frequently studied in research on VWs in education, it is interesting to note that inclusion and accessibility for minority groups are recognized as priorities for future research (Duncan, Miller, & Jiang, 2012). This suggests that the potential of collaboration in educational VWs between groups with different cultural backgrounds is not yet fully understood.

The incorporation of gamification in VWs for education is also important to consider (Berns, Gonzalez-Pardo & Camacho, 2013; Reisoğlu et al., 2017). Gamification is an umbrella term referring to the use of elements from video games in non-gaming contexts (Deterding et al., 2011). Common gamification strategies involve using motivational affordances, such as awarding points, achievements, or badges, providing an engaging story or theme, and displaying leader boards, progress bars, or other public representations of progress, to encourage competition among users (Hamari, et al., 2014; Park & Bae, 2014; Zichermann & Cunningham, 2011); such techniques may encourage users to aim for goals which can improve their performance on tasks (Landers, Bauer & Callan, 2015). VWs using gamification are

shown to increase collaboration and discussion about the curriculum, and to increase learning outcomes as a result (Johnson et al., 2014). The design of gamified VWs may therefore represent an important strategy for the future integration of international students into higher education. To maximise the potential effectiveness of such software, it will be important to ensure that the specific needs of international students are fully understood, and addressed in a meaningful way in the software. This may be achieved through inclusive design.

Inclusive Design

While inclusion in education is often primarily understood as the inclusion of people with disabilities and special educational needs, it is important to note that language and cultural differences may also be important factors to consider when aiming to make higher education inclusive (Messiou, 2017). This broad idea of inclusion is reflected in the concept of inclusive design. As defined by the Inclusive Design Research Centre (http://idrc.ocadu.ca/), inclusive design is, "design that considers the full range of human diversity with respect to ability, language, culture, gender, age and other forms of human difference". In the context of international students in higher education in Ireland, language and cultural differences are identified as important differences that can negatively affect the experience of students (Department of Education and Skills, 2016). Therefore, the inclusive design approach is, for the purposes of this study, defined as: the methodology of co-designing technological solutions with user groups to personalise their learning and communication tools and curriculum or content to best support each individual. In this project, all phases of the research involved consultation with the user group, and each phase ended with feedback to the user group to close the loop. Previously, we administered a questionnaire to international students from China at a university in Ireland (Zhang, 2017), to determine the specific challenges faced by these students. Our results showed that the broad issues identified by the Department of Education and Skills were reflected in these students' responses: language barriers, lack of cultural understanding, concerns about social integration, and concerns about the new teaching environment. The results also highlighted the need to provide information to international students, including information about courses at the university and about accommodation in the local area. Finally, we found that students would welcome a collaborative VW-based solution to these problems. However, while these results were extremely informative, they were still not specific enough to allow us to determine the functional requirements of such a system. In the present study, we provided a second questionnaire to international students from China at the university. Our aim was to identify specific needs and preferences of the students, which could inform the development of a VW to address some of the challenges they faced.

Inclusive design can also benefit from qualitative, empathy-driven approaches, such as empathic modelling (Altay & Demirkan, 2013). In these approaches, the designer aims to move beyond having

knowledge of the user, to relate to the user through an emotional connection. Techniques for achieving this include: (1) direct contact, through observation of, and communication with, the user; (2) conducting research about the user (it is recommended that designers view raw data, such as photographs and material written by the user, rather than data which has been analysed); and (3) simulating the user experience, such as through role-playing (Kouprie & Visser, 2009). The purpose of empathy-driven approaches in design is to diminish the distinction between user and designer, and some researchers suggest that the ultimate goal is to achieve "design by" the user, rather than the traditional "design for" approach, or indeed the "design with" approach of user-centred design techniques (McDonagh & Thomas, 2010). Here we present a fully-fledged "design by" approach: for the VW presented in this paper, the lead developer and researcher is a Chinese national (with 10 years' experience in the field of educational technology development and research), who moved to Ireland to study in the university in 2013. This offers a unique perspective on the design of the software. Not only could the developer reflect on their own experiences, and draw on their insight into the available technological solutions in both the Irish and Chinese contexts but their ability to communicate with other students from China with linguistic and cultural fluency, may have facilitated a more meaningful understanding of these students' requirements, perspectives, and differences.

Methodology

To alleviate the difficulties and challenges faced by Chinese international students, in terms of language barriers and cultural understanding (i.e., as identified in other research and our own previous work), we began the inclusive design and development of an efficient collaborative virtual campus (VC) (Zhang et al., 2016), at UCD, a large university in Ireland. The inclusive design applied in this study involves Chinese international students as the user group to help co-design the technological solutions and to personalise their own learning and communication tools. Based on our previous work (Zhang, 2017), a further questionnaire was developed to gather specific information about the needs, preferences and concerns of Chinese international students in UCD for creating a collaborative virtual campus (Zhang et al., 2016). The development of the questionnaire involved several steps. The first draft of the questionnaire was examined by colleagues with relevant research experience and then checked by experts in managing data collection. The Questionnaire was fielded by 10 PhD students to verify validity.

A Chinese-language version of the questionnaire was conducted in March 2016, with the support of the UCD Confucius Institute. The questionnaire was made by Google Forms and sent out to 173 UCD Chinese students who had a great variety of different levels and subject backgrounds. The questionnaire began by introducing the concept of a VC; example screenshots of VWs were also shown to students. The first part of the questionnaire established demographic information:

- Year of initial registration in the university.
- Gender.
- Age.
- College (i.e., faculty) affiliation within the university.
- Degree subject.
- Level (i.e., undergraduate, postgraduate taught, postgraduate research).
- Did the participant also take part in a previous questionnaire connected to this research?

The second part of the questionnaire had 10 questions. Questions 1-6 aimed to determine what specific content, resources, and features students would expect in a VC to address challenges faced by international students from China in Ireland. Question 7 asked students to identify specific software tools that they felt should be included in a VC. Questions 8 and 9 concerned students' preferences regarding games and gamification. Question 10 (free response) allowed students to make further comments and suggestions regarding the proposed VC. Two researchers – one native Chinese speaker who is fluent in English and one native English speaker – translated the Chinese-language version of the questionnaire together, discussing each question and response, to produce the English text given in Tables 1-9.

Thirty students (21-37 years; 19 female) completed the questionnaire. All 30 students were at the time registered in undergraduate or postgraduate programs at UCD. All 30 students' original country of domicile was China.

Results

By May 2016, 30 responses had been received, displaying a data recovery ratio of 17.34%. The mean age of the students was 25.8 (standard deviation 3.74). Most students who completed the questionnaire were registered in postgraduate courses (17 or 57%) research, seven (23%) taught). Almost half the students (13 or 43%) were registered in the College (faculty) of Science. Seven (23%) of the students had participated in a previous questionnaire related to this research. Full results from Questions 1-9 of Part 2 of the questionnaire are shown in Tables 1-9.

Table 1: Question 1 from the Second Part of the Questionnaire, with Results

"Which of the following virtual world features do you think would help improve English language skills of Chinese students prior to their arrival in Ireland?"	
Virtual World Feature	**Number of Students**
Set conversation topics to promote cultural exchange (e.g., the Great Wall of China, Chinese/Western music and film)	20 (67%)
Encouraging Chinese students and Western students to teach each other Chinese or English	18 (60%)
Regular social events (e.g., watching movies or live sports)	16 (53%)
Collaborative puzzle-based activities (e.g., traditional Chinese puzzles, computer programming tasks)	11 (37%)
Free English Corner (i.e., a scheduled English language group discussion)	9 (30%)
Paid English courses provided by Western students	9 (30%)
Free English online course provided by the university's international language centre	8 (27%)
Simple games for two or more people (e.g., chess, poker).	5 (17%)

Table 2: Question 2 from the Second Part of the Questionnaire, with Results

"Which of the following virtual world features do you think are the most important ones for addressing the issue of lack of knowledge about the university's course system?"	
Virtual World Feature	**Number of Students**
Providing information about the university's colleges (faculties) and subjects	18 (60%)
Providing information about the university's opportunities for elective (additional) study	18 (60%)
Provide course information categorised by level (i.e., undergraduate, masters, Ph.D)	17 (57%)
Providing information about examinations (including resitting failed examinations) at the university	17 (57%)
Message and reply board	17 (57%)
Providing information about the assessment structure of courses at the university	16 (53%)
Providing answers to frequently asked questions	15 (50%)
Providing information about the University's language learning programmes for international students	9 (30%)

Table 3: Question 3 from the Second Part of the Questionnaire, with Results

"Which of the following virtual world features do you think would be the most useful to improve the situation regarding finding accommodation for Chinese students?"	
Virtual World Feature	**Number of Students**
Showing the location and approximate price range of rental accommodation in the local area	23 (77%)
Providing a designated area (e.g., a wall) where users can share accommodation information	22 (73%)
Providing links to relevant website for accommodation in the local area	21 (70%)
Provide contact details of students and staff willing to provide accommodation to students from China	20 (67%)
Paid accommodation finding service	16 (53%)
Provide answers to frequently asked questions about accommodation in the local area	15 (50%)
Providing information on accommodation available in the university's halls of residence (e.g., prices, 3D models of room types)	14 (47%)
Providing information on accommodation available in the local area beyond the university (e.g., room types and apartment/house layout)	10 (33%)
Provide an online question and answer service	8 (27%)

Table 4: Question 4 from the Second Part of the Questionnaire, with Results

"Which of following virtual world features would be most helpful in order to inform Chinese students about the English learning environment, the university's teaching style, and counteract worries about not keeping up with the curriculum schedules?"	
Virtual World Feature	**Number of Students**
Provide videos of university courses to students while they are still in China	21 (70%)
Information about free course support services (e.g., writing support and computer support) offered by the university	17 (57%)
Provide virtual lectures, so that students can have an immersive experience of a course at the university before they move to Ireland	17 (57%)
Provide a library of free course materials, including videos of lectures	16 (53%)
Provide samples of course assignments and mid-term and final examination scripts	16 (53%)
Provide information on external online course (e.g., from coursera.org)	14 (47%)
Display interviews with teaching staff at the University in which they describe their teaching style	10 (33%)

Table 5: Question 5 from the Second Part of the Questionnaire, with Results

"Which of the following virtual world features would help Chinese students studying at the university to best understand Irish culture as well as the education and living conditions of Ireland?"	
Virtual World Feature	**Number of Students**
Provide information about supermarkets, Chinese supermarkets, and online shopping supermarkets in the local area	23 (77%)
An introduction to the living environment and facilities inside the university (e.g., restaurants, gym, swimming pool, bars)	20 (67%)
Provide information about public transport in the local area	19 (63%)
Explanation of the services provided by the university for Chinese students	17 (57%)
An introduction to Irish people's social preferences and customs in terms of non-work activities (pub culture, dance culture, etc.)	16 (53%)
An introduction to the weather characteristics of the local area	14 (47%)
An introduction to various cultural and folk festivals in the local area	13 (43%)
An introduction to the national festivals and holidays of Ireland	12 (40%)
An introduction to famous natural landscapes and attractions in the local area	12 (40%)
A virtual version of the university's International Chinese Office	12 (40%)

Table 6: Question 6 from the Second Part of the Questionnaire, with Results

"Which of the following virtual world features would help new Chinese students to integrate with other Chinese nationals in the local area?"	
Virtual World Feature	**Number of Students**
Allow Chinese students who have lived in the local area for some time to access the platform to share experiences and information	25 (83%)
Provide information about the university's Chinese Society	19 (63%)
Provide information about people using online social networking software that is popular in China (e.g., QQ messanger, WeChat)	17 (57%)
Provide contact information and address of the Chinese embassy in the local area	16 (53%)
Provide information on Chinese institutes in the university	14 (47%)
Provide a Chinese-language live help facility	13 (43%)
Provide contact information of Chinese representatives in the university's International Office	10 (33%)

Table 7: Question 7 from the Second Part of the Questionnaire, with Results

"Which of following virtual world features would facilitate information sharing, communication, and collaboration between Chinese and Western students?"	
Virtual World Feature	**Number of Students**
Opportunity to upload multiple documents and file types, such as pictures, PPT and PDF, etc.	18 (60%)
3D virtual campus tour	16 (53%)
Function for downloading documents from the 3D virtual campus	14 (47%)
Integrated Google search	13 (43%)
Voice chatting	13 (43%)
English-Chinese language translator	12 (40%)
Ability to open links to videos or webpages within the platform	12 (40%)
Video chatting	12 (40%)
Private and group text message	12 (40%)
Collaborative learning tools for functions such as painting, problem solving, English writing, computer coding, etc.	11 (37%)
University image	11 (37%)
Counselling facilities	10 (33%)
Multilingual translation function	10 (33%)
Opportunity to make presentations in the platform	8 (27%)
Screen sharing function	8 (27%)
Provide teaching videos in Chinese for Western students	7 (23%)
Ability to take screenshots	7 (23%)
Ability to record a session as a video	7 (23%)
An area for teaching Chinese, with a white board function for drawing Chinese characters	6 (20%)
Local area weather forecast	4 (13%)
Continuous recording of the communications online	4 (13%)

Table 8: Question 8 from the Second Part of the Questionnaire, with Results

"What kind of game features should be included in a virtual world to facilitate social interaction and collaboration between Chinese and Western students?"	
Game Feature	**Number of Students**
Providing points for specific interactions between Chinese and Western students (e.g., sending messages, engaging in video chat, sharing documents)	21 (70%)
Access to resources (e.g., language course, campus tours) is given as a reward for time spent communicating with students from a different cultural background	14 (47%)
Providing simple collaborative text-based puzzle games, with points accumulated displayed on a leader board	8 (27%)
Providing simple table-style games (e.g., chess), with points accumulated displayed on a leader board	7 (23%)

Table 9: Question 9 from the Second Part of the Questionnaire, with Results

"Would you prefer to be required to play games (i.e., to obtain points) to gain access to information and resources, or be able to access information directly?"	
Response	**Number of Students**
Direct access to information and resources	23 (77%)
Play games to access information and resources	7 (23%)

Discussion

Main Findings

In this section, we discuss our findings in terms of several general themes we can identify. In doing so, we show how these findings may be of interest to designers of VWs and gamification to improve integration of international students from China in an English-language university in a European country. In addition, we believe that these findings would be of interest to those seeking to integrate culturally diverse student bodies more generally (i.e., not merely in terms of VWs and gamification).

Improving Language Skills: Informal Social Activities rather than Structured, Formal Courses

When students were asked how they would like to improve their language skills in a VC, formal language courses (either paid or free) were less popular than informal collaborative activities, such as conversation, mutual language teaching, and social interaction (Table 1). In addition, when we asked students what features they would like a VC to contain to address their lack of knowledge about the university, the least popular option was information about the university's language learning courses for international students (Table 2). This suggests that structured language courses may not be the preferred way to improve language skills of international students. This may be because international students at English-language universities will presumably be relatively proficient in English (often this is a requirement of admission). Alternatively, it may be that international students, who have moved to a new country primarily to study a university course, do not want to have to take part in additional courses to also improve their language skills. As a final possible explanation, it could be that, while international students do wish to improve their languages skills, they are equally concerned (or perhaps more concerned) about making friends in the new setting.

A Wide Range of Information

Some of the questions were designed to determine what kinds of information international students would appreciate in a VC to address the general issues which we identified in our previous research (e.g., lack of knowledge about the university, concerns about differences in teaching style). Students

would like to receive information about the academic structure of the university, courses available (including elective courses), examinations and assessments (Table 2), and information on the locations and prices of accommodation available in the local area (Table 3). These are perhaps unsurprising findings but it is interesting to note the wide range of additional information students would appreciate: information on local supermarkets and public transport were both popular, and – while not as popular – some students would like information on the social customs and preferences of Irish people (53%) and the local weather (47%) (Table 5). This shows that rich information, not just about university life, but also about daily life in Ireland, is important to the students.

Social Interaction

1) The most popular way to improve English language skills involved communication and cultural exchange. (Table 1).

2) In terms of features to help students find useful information about accommodation, the second most popular option involved having a designated space in the virtual campus where students could share and exchange information (Table 3).

3) When students were asked about gamification features to increase collaboration, rewarding points for specific social interactions between students with different cultures was the most popular choice (Table 8).

4) Across all categories of features, the opportunity to interact with other Chinese students who have lived in the area for some time was the most popular feature overall (83%; Table 6).

Additional features involving connection with other Chinese students, such as providing information about Chinese messaging software QQ and WeChat, and the university's Chinese Society, were also popular (Table 6). Clearly, while the students who participated in this study do want to integrate with non-Chinese students to improve their language and local cultural understanding through a VC, they also think it is important to connect with other Chinese students who may be more familiar with life in Ireland. It is possible that students view this as a particularly effective and safe way to come to understand their new environment.

Digital Tools

Many of the software tools discussed by respondents in the questionnaire (e.g., the ability to upload, download, and share documents; text, video, and audio chat)
(Table 7), are built-in features of standard VW platforms, such as Terf®
(http://www.3dicc.com/product-details/). This demonstrates the utility of using off-the-shelf

solutions in the development of VWs. However, it is interesting that, apart from the ability to upload documents and access a 3D campus tour, all other software tools were selected by less than half of the students (Table 7). Again, this may illustrate the importance students attached to social and cultural integration, and receiving practical information on life at the university and in the local area; features relating to these issues generally scored higher than specific software tools (compare Tables 1-6 with Table 7).

Virtual Learning Environment

Adapting to a different teaching and learning style is identified as a specific challenge for Chinese students in Ireland (Feldman et al., 2008). To address this issue, the students who participated in this study would like to experience lectures virtually and see samples of course materials and assignments; the least popular option was to view videos in which lecturers at the university describe their teaching style. Given that this question specifically asked students how they would prefer to learn about the teaching style in the university, it is notable that virtual experiences were more popular than direct explanation (Table 4). This may highlight some of the unique affordances of immersive VWs. Similarly, students would welcome the opportunity to experience a virtual tour of a 3D model of the university campus (Table 7). This also shows the potential value of the immersive experiences facilitated by VWs.

Games and Gamification

We found that simple text-based puzzle games or table-style games were not popular (Table 8). This is interesting because previous VWs for cultural and language learning have used text-based puzzle games with some success (Inaba et al., 2015; Zheng et al., 2009). However, our findings suggest that such games may not be the most preferred option for students. In turn, this suggests that it may be valuable to explore other kinds of games for cross-cultural learning in VWs.

Most students said that they didn't want to play games to access resources but, instead, be able to access resources directly (Table 9). This shows that gamification, while it has many potential benefits, must be implemented carefully. Gamification should be used to increase engagement with a system but not be a barrier to information and resources. As one student put it in answer to the free response question:

> …the points based system will force students to participate instead of based on their own initiatives… A bonus system might be a better idea, so that all resources are accessible, but students can have extra bonus when having participated a lot in the virtual system

In terms of specific gamification features, most students would prefer to receive points for interactions with students from a different cultural background, rather than receive points for simply playing

games (Table 8). Again, this suggests that gamification should be used primarily to encourage engagement with other students (e.g., to provide a motivation to initiate a video chat with another student). Combined with the findings that: (1) students prefer collaborative, social activities to improve language skills (rather than formal language courses), and (2) simple text-based puzzle games (as used in previous research in this area) were not popular, this suggests an important area for future work: the development of new kinds of gameplay and gamification for cross-cultural collaboration in VWs. In the following section, we will show how we have explored this by developing original cross-cultural collaborative games.

Application of the Findings: Development of a Virtual Campus

We have shown how an inclusive design process led to a series of general findings about the requirements of Chinese students in Ireland. In this section, we describe how we used these findings in the development of a VC for international students from China at UCD. The VC is a bilingual (English and Chinese) VW in which students from China can meet and collaborate with Western students, both before and after their migration to Ireland (Zhang et al., 2016).

Platform and Basic Functionality

The VC was developed in Terf®, a VW platform which provides a broad range of digital tools for users, such as uploading/downloading documents, images, videos, video chat, audio chat, group text chat, private text chat, the ability to record sessions, and the ability to take screenshots. Additionally, Terf® integrates a unique combination of teamwork tools: the ability to share a window, live video, co-editing tools (such as the ability to share the mouse and keyboard), document tools, and electronic whiteboards. Terf® also incorporates permission-based administrator functions to limit access to specific resources, and the ability to import 3D objects that may be created in various 3D modelling programmes. Custom applications, such as games, can be embedded in Terf® as Python applications, and the platform can be linked to an external database, so that, for example, players' scores can persist between sessions. These features mean that Terf® meets many of the requirements identified in the present research (Table 7).

Figure 1: A scene from the virtual campus.

3D Content

One particularly interesting result from the questionnaire was that the most popular option to provide interaction between students from China and Ireland to improve speaking and writing skills was to provide content that facilitated cultural exchange. Accordingly, the VC includes a range of items associated with both China and UCD (Figure 2). In addition, our previous research found that students from China would welcome a 3D model of the university campus, as the campus is quite large; and in the work reported here, we found that students would appreciate a 3D campus tour (Table 7). A 3D model of the campus was therefore embedded in the VC, so that students could explore the university in an immersive way (Figure 3).

Figure 2: 3D artefacts to promote cultural exchange: Traditional Chinese lanterns hang in a room in the virtual campus.

Figure 3: A 3D model of UCD embedded in the virtual campus.

Original Cross-Cultural Collaborative Games and Gamification

One of our main findings was that only certain approaches to gamification would be welcomed by students. Based on these findings, we developed the concept of the cross-cultural collaborative game (CCG) (Zhang et al., 2016). A CCG is a game-like experience in which users from different cultural backgrounds are encouraged to engage with and share information in a mutually beneficial process. For example, the VC features a word game, in which players must compete in cross-cultural teams (Figure 4). The game was designed so that teams of players would control their avatars to work together on a 3D dynamic puzzle. The aim of the game is to identify terms (in English). We selected a word game, as this style of play can facilitate the two most popular options selected by students for encouraging interaction with the aim of improving language skills and cultural understanding: use of cross-cultural themes and collaborative language learning (see Table 1). For example, students from China may not know what Hurling is (a traditional Irish sport), so by incorporating a sports theme in the word game, students from China may engage in a discussion with students from Ireland (using video, audio, or text chat), to understand traditional Irish sports. Through the process of completing the word game collaboratively, we expected that players would have social interactions, cultural knowledge exchange, and potentially increase their English language proficiency. Points earned by players in the games are displayed on a score board. It is important to note, however, that in adding games to the VC, our aim is to encourage students to engage with each other around the relevant information and resources, rather than making access to the resources dependent on success in a game.

Thus, we use principles of gamification to embed information in a game-like experience but we do not restrict access to information and resources by treating them as rewards for gameplay.

A more detailed description of the VC is provided in (Zhang et al., 2016). A user evaluation study of the software was conducted, and will be reported in full in future work. Initial results show that gamification does encourage interaction between cross-cultural teams, and that playing CCGs encourages cultural exchange and potentially improves language skills.

Figure 4: An example of a collaborative cross-cultural game. This game requires users to identify words associated with both China and Ireland, thus encouraging collaboration and cultural exchange in cross-cultural teams to succeed.

Limitations

One possible limitation of the work reported here is that the results from the questionnaire may not be reflective of a broad range of Chinese students. Over half the students who completed the questionnaire were postgraduate research students; another seven students were postgraduate taught students. In addition, the mean age of students was 25.8. It may be that a more varied sample, incorporating more undergraduates and younger students, would produce different results. Of course, it is feasible that many of the features we identified (e.g., information on accommodation and social activities) would appeal equally to all students, regardless of age or level of study. It would be informative, nevertheless, to investigate the preferences of a wider range of students in future work.

In terms of the software we developed, some limitations with the Terf® platform may be identified. Although the platform incorporates many useful collaboration tools, the version of Terf® we used was somewhat out of date, leading to some issues with obtaining compatible software libraries when attempting to add functionality (e.g., importing and running the CCGs as Python applications).

Alternative platforms could be used in the future. For example, OpenSimulator (sometimes known as OpenSim) is an open-source 3D application server. It can support online 3D environments with multiple simultaneous users, be accessed via multiple clients, and may be used to create collaborative VWs like the one reported in this paper (Che, Lin, & Hu, 2012). Similarly, a large amount of research on 3D learning environments has used Second Life, a popular online VW (Reisoğlu et al., 2017). It is also interesting to note that 3D game engines, such as Unity, Unreal Engine, and CRYENGINE, also allow the creation of collaborative 3D virtual environments. While such software is typically used to create video games, it is also possible to create non-game virtual environments with these tools. Indeed, given that we have emphasised the value of gamification in the VC, game engines may provide advantages that traditional tools such as Terf® do not offer (Trenholme & Smith, 2008).

A further limitation of the software developed is found in the implementation of gamification features. While we have implemented original CCGs, we have not currently implemented a system wherein points are awarded for engaging in specific interactions with students from a different cultural background (e.g., initiating a video chat), which was the preferred choice of the students who completed the questionnaire (Table 8). In future work, we aim to develop such a system and incorporate it into the VC.

Finally, we note a more general potential limitation in the use of VWs for people based in China. It is important to remember that participation in VWs typically requires access to a high-speed Internet connection. Since we intend that the VC developed here could also be used by students in China (i.e., before they move to Ireland), this may present issues in some parts of the country; some have expressed concerns about the feasibility of plans to make high-speed broadband more widely available in China, suggesting that over-reliance on state-owned carriers and unnecessary political involvement may affect the successful implementation of China's national broadband plan (Liu, 2016).

Empathic Inclusive Design

This study is also an example of the importance of empathy in inclusive design. By having first-hand experience of being an international student from China in Ireland, the lead researcher who developed this project could identify in detail how collaborative, technology-driven solutions were able to increase inclusion in their personal circumstances. This provided a level of insight into the development of both the questionnaire and the resulting software, which may not have been afforded to a developer without this experience. Other factors, such as being able to communicate with potential users with native linguistic and cultural fluency, may also have increased the involvement of students from China in the development process. Furthermore, the ability to understand the feelings which international students from China may experience both before and after moving to Ireland (for

example, being anxious about the teaching style at Irish universities) and the ability to reflect on what practical solutions did or may have done helped to alleviate these feelings in the developer's personal circumstances (e.g., having a culturally diverse group of colleagues), we can claim that the VC presented here is a clear example of design *by* the user.

Future Work

In future work, we aim to explore the use of emerging technologies such as augmented reality for cross-cultural collaboration and language learning in education. We also aim to develop VWs in alternative platforms, such as Unity and OpenSimulator. We suggest that collaboration between China and Western countries such as Ireland will be of increasing importance in the future, and, as recognised at both the level of research and governmental policy, approaches will be required to increase inclusion and collaboration in international education. We believe that combining inclusive design techniques with novel technology development, as in the development process reported in this paper, will represent one important strategy to effectively meet these growing challenges.

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